Secular Climate Change on Mars: An Update Using MSL Pressure Data

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The South Polar Residual Cap (SPRC) on Mars is an icy reservoir of CO2. If all the CO2 trapped in the SPRC were released to the atmosphere the mean annual global surface pressure would rise by ~20 Pa. Repeated MOC and HiRISE imaging of scarp retreat rates within the SPRC have led to the suggestion that the SPRC is losing mass. Estimates for the loss rate vary between 0. 5 Pa per Mars Decade to 13 Pa per Mars Decade. Assuming 80% of this loss goes directly into the atmosphere, and that the loss is monotonic, the global annual mean surface pressure should have increased between ~1-20 Pa since the Viking mission (19 Mars years ago).

Surface pressure measurements by the Phoenix Lander only 2 Mars years ago were found to be consistent with these loss rates. Here we compare surface pressure data from the MSL mission with that from Viking Lander 2 (VL-2) to determine if the trend continues. We use VL-2 because it is at the same elevation as MSL (-4500 m). However, based on the first 100 sols of data there does not appear to be a significant difference between the dynamically adjusted pressures of the two landers. This result implies one of several possibilities: (1) the cap is not losing mass and the difference between the Viking and Phoenix results is due to uncertainties in the measurements; (2) the cap has lost mass between the Viking and Phoenix missions but it has since gone back to the cap or into the regolith; or (3) that our analysis is flawed.

The first possibility is real since post-mission analysis of the Phoenix sensor has shown that there is a +3 (±2) Pa offset in the data and there may also be uncertainties in the Viking data. The loss/gain scenario for the cap seems unlikely since scarps continue retreating, and regolith uptake implies something unique about the past several Mars years. That our analysis is flawed is certainly possible

owing to the very different environments of the Viking and MSL landers. MSL is at the bottom of a deep crater in the southern tropics (~5°S), whereas VL-2 is at a high latitude (~48°N) in the northern plains. And in spite of the fact that the two landers are at nearly identical elevations, they are in very different thermal environments (e.g., MSL is warm when VL-2 is cold), which can have a significant affect on pressures. For these reasons, our confidence in the comparison will increase as more MSL data become available. We will report the results up through sol 360 at the meeting.